PATHOLOGY AND BACTERIOLOGY

UNDER THE CHARGE OF
OSKAR KLOTZ, M.D., C.M.,
PROFESSOR OF PATHOLOGY AND BACTERIOLOGY, UNIVERSITY OF PITTSBURGH, PITTSBURGH, PA.

(1) The Oxygen of the Arterial and Venous Blood in Pneumonia and its Relation to Cyanosis. (2) The Oxygen and Carbon Dioxide Content of Arterial and of Venous Blood in Normal Individuals and in Patients with Anemia and Heart Disease. (3) Studies of Cyanosis. (I) Primary Causes of Cyanosis, (II) Secondary Causes of Cyanosis, (III) Erythrosis, or False Cyanosis.—The grouping of five recent studies of the blood gases in a variety of conditions, with especial reference to cyanosis, virtually constitutes a monograph on the subject. These papers, in that they are so closely related, may well be reviewed together. I.—STADIE (*Jour. Exper. Med.*, 1919, xxx, 215), impressed by the unusual frequency and intensity of the cyanosis of influenzal pneumonia, investigated the blood gas content in five normal individuals and in 33 patients with pneumonia. In the course of this work, he perfected a simple technic for arterial puncture. On normal subjects, the arterial unsaturation (the value indicating the difference between the actual and the possible oxygen content of a given specimen of blood) was found to be 5 per cent. of the total oxygen capacity. The venous unsaturation was 26.8 per cent. of the total oxygen capacity. In pneumonia, there was a great variation in findings. The arterial unsaturation ranged from 0.0 per cent. to 68.2 per cent., the venous from 14.4 per cent. to 85.5 per cent. It was generally found that an arterial unsaturation of over 20 per cent. was associated with the fatal outcome. The mean arterial unsaturation in fatal cases was 32 per cent. against 13.9 per cent. in the non-fatal ones. The venous unsaturations correspondingly averaged 57 per cent. and 36.3 per cent. Patients without cyanosis showed an arterial unsaturation very close to the normal, the mean figure being given as 5.4 per cent. A definite relation exists between arterial unsaturation and the appearance of cyanosis. The more marked the cyanosis, therefore, the greater is the degree of arterial unsaturation. Hence, the deduction is made that cyanosis in this type of pneumonia is due to incomplete oxygenation of venous blood in the lung. As the oxygen capacity was found to be even slightly higher than the normal (indicating a concentration of the blood) methemoglobinemia in the cases studied, was evidently a negligible factor. Stadie points out that none of the patients could be considered true lobar pneumonia so that this is not evidence against the possible occurrence of methemoglobin formation in that condition. Oxygen consumption, estimated as the difference between arterial and venous oxygen content, was not below normal limits; this indicates that the cardiac output is not diminished in influenzal pneumonia, thus corroborating the postmortem finding in regard to the heart. II.—HARROP (*Jour. Exper. Med.*, 1919, xxx, 241) studied a group of 15 normal individuals, in whom he established the oxygen unsaturation of arterial blood at 4.5 per cent. a figure closely corresponding to that found by Stadie. No difference in arterial oxygen content was found at diverse points in the peripheral circulation. The blood, therefore, suffers practically no alteration in passage from the lung to the terminal arterioles and capillaries. This adds force to Stadie's point regarding cyanosis as an evidence of incomplete oxygenation of the blood leaving the lesser circulation. The normal individual after exercise showed lowered oxygen saturation, and at the same time, lowered carbon dioxide content of the arterial blood. In anemic patients, the arterial oxygen saturation was normal. The venous blood, however, showed low absolute value for oxygen content. But the oxygen consumption was maintained at normal. Cases of heart disease, without evidence of change in lungs, and at rest in bed, showed normal blood gas findings. The pernicious effect of lung involvement in connection with heart disease, resulting in interference with gaseous interchange, and the relation of this complication to cyanosis, is well brought out in a series of estimations on patients with cardiac decompensation and pulmonary changes. Patients with decompensation exhibited a marked degree of arterial unsaturation, which tended to return to normal as compensation was reëstablished, but only did so when the pulmonary lesions cleared up. A marked degree of arterial unsaturation was accompanied by an increase in oxygen consumption and as the degree of arterial unsaturation became less so was the oxygen consumption lowered toward the normal. These observations are entirely in accord with those of Stadie, pointing as they do to a pulmonary basis for the alteration in blood gas content. III.—LUNDSGAARD (*Jour. Med. Res.*, 1919, xxx, 259, 271 and 295) states, as the result of the analysis of venous blood in a considerable group of individuals with and without cyanosis, that neither increased carbon dioxide content of venous blood, nor low absolute oxygen content of venous blood has any relation to the clinical finding of cyanosis. He believes, rather, that increase of oxygen unsaturation of venous blood (*i. e.*, the presence of a difference greater than normal between the oxygen actually present in the venous blood and the total oxygen combining power of that blood) is the primary cause of cyanosis. As Lundsgaard has previously demonstrated, the normal resting individual never shows an oxygen unsaturation in the venous blood greater than 8 volumes per cent. This is interesting in view of the finding that among the patients with cyanosis, none showed a venous oxygen unsaturation below the figure just named. Apparently, then, at least this degree of unsaturation must be attained before cyanosis is possible as a clinical finding. But this does not mean that cyanosis invariably occurs at this point. A further study of the findings shows that only in event of a venous oxygen unsaturation of 13 volumes per cent. or greater was cyanosis always present. Why venous oxygen unsaturation up to 13 volumes per cent. may be found without cyanosis is explained by Lundsgaard on the basis of oxygen saturation of the arterial blood reaching the capillaries from the lungs. If this blood is completely saturated, a venous oxygen unsaturation of 13 may be reached before cyanosis appears. But if the arterial blood is not saturated with oxygen, cyanosis develops more readily, appearing with a venous oxygen unsaturation of 8 volumes per cent. The degree of arterial unsaturation in cyanosis may thus be estimated from the degree of venous unsaturation present. Pulmonary disorders, as a rule, give rise to oxygen unsaturation, and are to be suspected even in absence of physical signs. The principal secondary cause of cyanosis, then, is a partial reduction (or incomplete oxygenation) of arterial blood going to the peripheral circulation, resulting from interference in gaseous interchange by some affection of lung and heart. Another secondary cause is decreased oxygen tension in the alveoli, as occurs in high altitudes. The second important secondary cause of cyanosis is increased reduction of the blood during its passage through the capillaries as in active physical exertion, and accompanying the retarded blood flow of decompensated heart lesions. Finally, Lundsgaard has studied the venous blood of a patient having the condition named erythrocythemia rubra vera by Osler. Here the normal oxygen unsaturation was found, though the hemoglobin and the total oxygen capacity were abnormally high. The carbon dioxide content was normal. By reason of the curious brick-red dusky color of the skin (false cyanosis), the term "erythrosis" is proposed as the name of the condition. This would seem to be no improvement on the former name, since it is less descriptive of the condition.

Contribution to Predisposing Factors in Pulmonary Tuberculosis.—Various views are held upon the direct and indirect influence of artificial pneumothorax upon the progress of tuberculosis in the human. Some have claimed that the collapsed lung is subject to a condition of venous stasis which is antagonistic to the progress of a tuberculous infection. SHAW (*Am. Rev. Tuber.*, 1919, iii, 410) in a limited number of animal experiments comes to conclusions at variance with the above conception. The production of artificial pneumothorax followed either by intravenous inoculation or intratracheal inoculation of tubercle bacilli was followed by the development of tuberculous lesions within the collapsed lung, while the lung of the opposite side remained free. He suggests that these findings should receive consideration in the analysis of spontaneous human infection.

Primary Spontaneous Tumors of the Testicle and Seminal Vesicle in Mice and Other Animals.—Tumors of the testicle in lower animals seem to be very rare as very few instances can be found in the literature. Those reported have occurred for the most part in horses and dogs. There is not a single instance of such a tumor occurring in mice. The authors, SLYE, HOLMES and WELLS (*Jour. Cancer Res.*, 1919, iv, 207) can add from their series of 19,000 autopsies on mice dying natural deaths, 28 instances of primary tumor of the testicle. Most of these resemble the human tumor in every respect being composed of epithelial cells closely resembling those of the seminiferous tubules and arranged in an alveolar structure. The tumors are usually very vascular with large blood channels, the walls of which are often composed solely of tumor cells. Cells with atypical and giant nuclei are common and multinucleated cells are often found. For the most part these new growths of the testis are essentially benign in character, developing very slowly, rarely ulcerating, generally distinctly limited by the tunica albuginea and in no case with distinct remote metastases. One case presented a series of six contiguous independent nodules and one case showed bilateral testicular tumors. Two of the growths resembled typical spindle-cell sarcoma, one arising at the site of a wound. Three of the so-called orchidoblastomas followed trauma. There was no evidence that any of these neoplasms had arisen in a teratomatous growth and no true teratomas were observed, this in direct contrast to the frequency of teratomas in the human testicle. With the exception of one tumor all the 28 neoplasms of the testis in mice occurred in members of a single strain of mice and its hybrid derivatives, thus bearing out the theory that heredity influences the incidence of tumor development in different organs or tissues. This fact may account for the absence in the literature of recorded cases of tumor of the testis in mice from other laboratories. As for tumors of the seminal vesicles the authors found one case of polymorphous-cell sarcoma, apparently only the second case on record of such a growth in the seminal vesicle of a lower animal.

Cancer in Hainan, China.—It is generally agreed that cancer is a disease occurring after middle life and due to a variety of causes but despite an almost innumerable list of possible contributing factors the subject still remains an unsolved problem. Bercovitz (*Jour. Cancer Res.*, 1919, iv, 229) has found in studying the disease among the Chinese a number of phases differing from those usually encountered. It must be noted that medical conditions in China are very different from those of the western world and may account in a large measure for the differences which the author found. Many cases do not come to the hospital until inoperable and only after all native remedies have failed. Until very recently prejudice has kept women away from medical and surgical aid. A striking point of difference which the author offers without being able to give any explanation for it is that cancer in China is as much a disease of the early decades of life as of the later. Of 131 cases of cancer 50.3 per cent. occurred before the age of forty. The most frequent locations of malignant growths are the penis, skin and cervical glands. The only reasons to be assigned for these sites are the high incidence of syphilis among the Chinese male population and attempts to cure the primary lesion by the application of highly caustic native remedies. Counter-irritation is extensively practiced by the Chinese to drive out evil spirits supposed to be the cause of disease. Moreover the Chinese are as a rule very scantily clad. The arms, trunk and legs of the men who work in the fields being bare, the rays of the sun may be a contributing factor. The author is unable to explain the great frequency of cancer of the cervical glands unless perhaps through infection from the throat since in most cases there are no marks on the neck to indicate previous counter-irritation. The author notes the infrequency of cancer of the stomach and of the uterus. For the former he offers the explanation that certain virulent streptococcic infections which according to Rosenow are responsible for gastric ulcer are not found among the people of Hainan. Infections due to streptococci, as scarlet fever, appendicitis and acute articular rheumatism (non-gonorrheic) are practically unknown in that part of China. The only reason to be given for the infrequency of cancer of the uterus is the one noted above that until very recently women have not sought medical aid. It is rather suggestive, too, that the virulent infections of the female generative organs seem to be infrequent among the Chinese.